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RESEARCH DEPARTMENT

A test of the effectiveness of precision-best offset operation applied to the interference patterns generated by chrominance frequency-changing

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THE BRITISH BROADCASTING CORPORATION
ENGINEERING DIVISION

RESEARCH DEPARTMENT

A TEST OF THE EFFECTIVENESS OF PRECISION-BEST OFFSET OPERATION APPLIED TO THE INTERFERENCE PATTERNS GENERATED BY CHROMINANCE FREQUENCY-CHANGING

Report No. T-110
(1963/25)

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SUMMARY

It has been proposed that the exchange of programmes between Europe and America might be facilitated by the use of a 525-line, 60 field per second European standard in addition to the present 625-line, 50 field per second standard. In the case of colour television transmissions, this would involve changing the frequency of the chrominance information, and a difference frequency component might be generated which would produce an interference pattern. A test is described for assessing the advantage of arranging that this difference frequency has a 'precision-best' relationship with the line- and field-scan frequencies.

1. INTRODUCTION

It has been suggested[1] that European television transmissions should take place on dual standards: 625-line, 50 field per second (625/50) pictures for broadcasting within Europe only and 525-line, 60 field per second (525/60) pictures for exchange of programmes with America without involving the need for standards conversion. In the case of an NTSC-type system of colour television the relationships between the colour subcarrier frequency and the two line-scan frequencies of such dual standards must be examined. The European subcarrier frequency must be identical for both the 625/50 and the 525/60 transmissions and it is clearly very desirable to keep this frequency as close as possible to the value already provisionally chosen (4,429,687·5 c/s). The American subcarrier frequency, however, is 3,579,545 c/s and when programmes are exchanged between Europe and America it will be necessary to remove the chrominance information, change its frequency, and re-insert it in the video spectrum. It will probably be difficult to remove the original chrominance information completely, and the residual information on the original frequency will tend to beat with the new subcarrier and produce interference patterns at the difference frequency (approximately 850 kc/s).

According to which of various proposals[1, 2] are adopted the difference frequency D could be related to the line frequency L and the field frequency F by one of the following equations:

$$D_1 = 56L \tag{1}$$

$$D_2 = 54L \tag{2}$$

$$D_3 = 54L + 8F \tag{3}$$

$$D_4 = 54L + 17F/2 \tag{4}$$

Interference at frequency D_1 produces a pattern of stationary vertical stripes. A change to frequency D_2 will merely alter slightly the spacing between the stripes, and should have no perceptible effect on the visibility of the pattern. A change to frequency D_3 should merely cause the stripes to be inclined by 12·5°, and again their visibility should not be changed. D_4 differs from a multiple of the line frequency by an odd multiple of half the field frequency, and the pattern of stripes should therefore be reversed in phase in alternate fields. This reversal reduces the visibility of the pattern. For this reason equation (4) is said to show a 'precision-best'[3] relationship between D_4, L and F.

This report describes an experiment to determine the magnitude of the advantage that would be gained by choosing a subcarrier frequency that would cause the interfering beat frequency to be D_4 rather than D_3.

2. EXPERIMENTAL DETAILS

The arrangement of equipment for the test is shown in Fig. 1. The picture source generated a 525-line, 60 field per second Test Card 'C' waveform, and known amounts of the 850 kc/s c.w. interfering signal could be added to this before the picture was displayed on a 21-inch (53 cm) monitor. The interfering signal was derived from a frequency synthesizer which could be controlled in frequency to within ± 1 c/s. The picture source was operated asynchronously, that is, its field frequency was not in synchronism with that of the electricity supply, but some drift of the field frequency was apparent. Nevertheless the frequency of the interference could be controlled manually, by observation of the picture display, so as to maintain the relationship of either equation (3) or equation (4) for long enough to enable an assessment of the pattern visibility to be made. All the equipment was powered by a 60 c/s supply. The assessments were made by five experienced observers, who, when seated at a distance of five times the picture height from the display, each equated the visibility of patterns due to interference at frequencies D_3 and D_4.

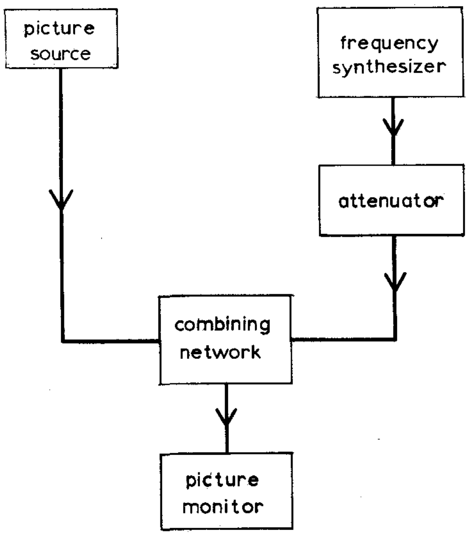

Fig. 1 - Block diagram of equipment arrangement

3. RESULTS

The ratio of the amplitude of the wanted signal to that of the interfering signal required to produce an interference pattern of a certain visibility in the 'precision-best' condition (equation (4)) was on average about ten decibels less than the ratio required to produce a pattern of the same visibility in the condition corresponding to equation (3). This difference in the amount of signal required in the two cases did not depend on the absolute degree of pattern visibility.

Although this result was obtained with a continuous sinusoidal interfering signal, it seems reasonable to expect it to provide a useful guide to the result that would have been obtained with interference due to beats between two colour subcarriers, each of which would be amplitude-modulated in accordance with variations in brightness and saturation in the scene. Continuous wave interference would in fact be produced if the scene consisted of a uniform coloured area; this is probably the condition leading to the most annoying interference.

4. CONCLUSIONS

The interference pattern, which may be produced when the frequency of the chrominance information is changed during the exchange of programmes between Europe and America using the 525-line, 60 field per second standard, can be substantially reduced in visibility by arranging that the difference-frequency component giving rise to the pattern differs from a multiple of the line-scan frequency by an odd multiple of half the field-scan frequency. The extent of this reduction in visibility is equivalent to that resulting from a reduction of at least ten decibels in the difference-frequency component.

5. REFERENCES

1. CCIR IXth Plenary Assembly, Los Angeles, 1959. Document 97, 15th January, 1959.

2. 'Subcarrier Relationships for Dual-Standard Colour Television', Research Department Technical Memorandum No. T-1049.

3. Hopf, H., 'Experiments on the Operation of Television Transmitters with Precision-Offset Carrier Frequencies', Rundfunktechnische Mitteilungen, December 1958.

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